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None

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(54) **Pultruded profile surface finishing**

(57) The invention relates to a method of manufacturing cored or non-cored pultruded profiles having a skin. The method comprises feeding a skin forming material (9, 9a) to the inlet of a primary pultrusion die station (8) which includes a resin curing die (16, 17, 18) having a cross-sectional shape for determining the cross-sectional shape of the profile. Bonding resin is introduced to the die station (8) and the resin bonded primary profile which emerges from the outlet of the primary die station (8) is fed through a secondary die station (80) which includes a curing die (65) having a cross-sectional shape substantially similar and slightly oversize in relation to the primary profile (24). Surface finish material is introduced to the secondary die station (80) to coat the primary profile (24), and the finished profile (82) is pulled from the outlet of the secondary die station (80).

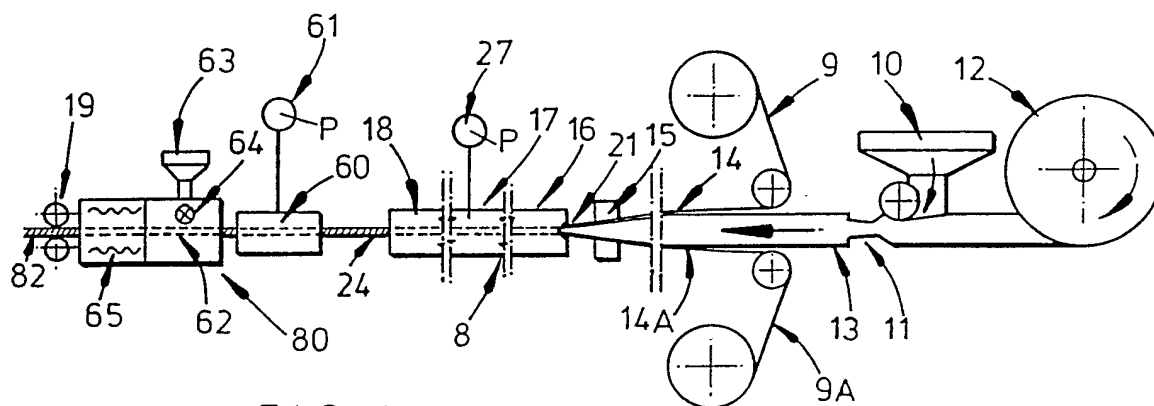


FIG. 1A

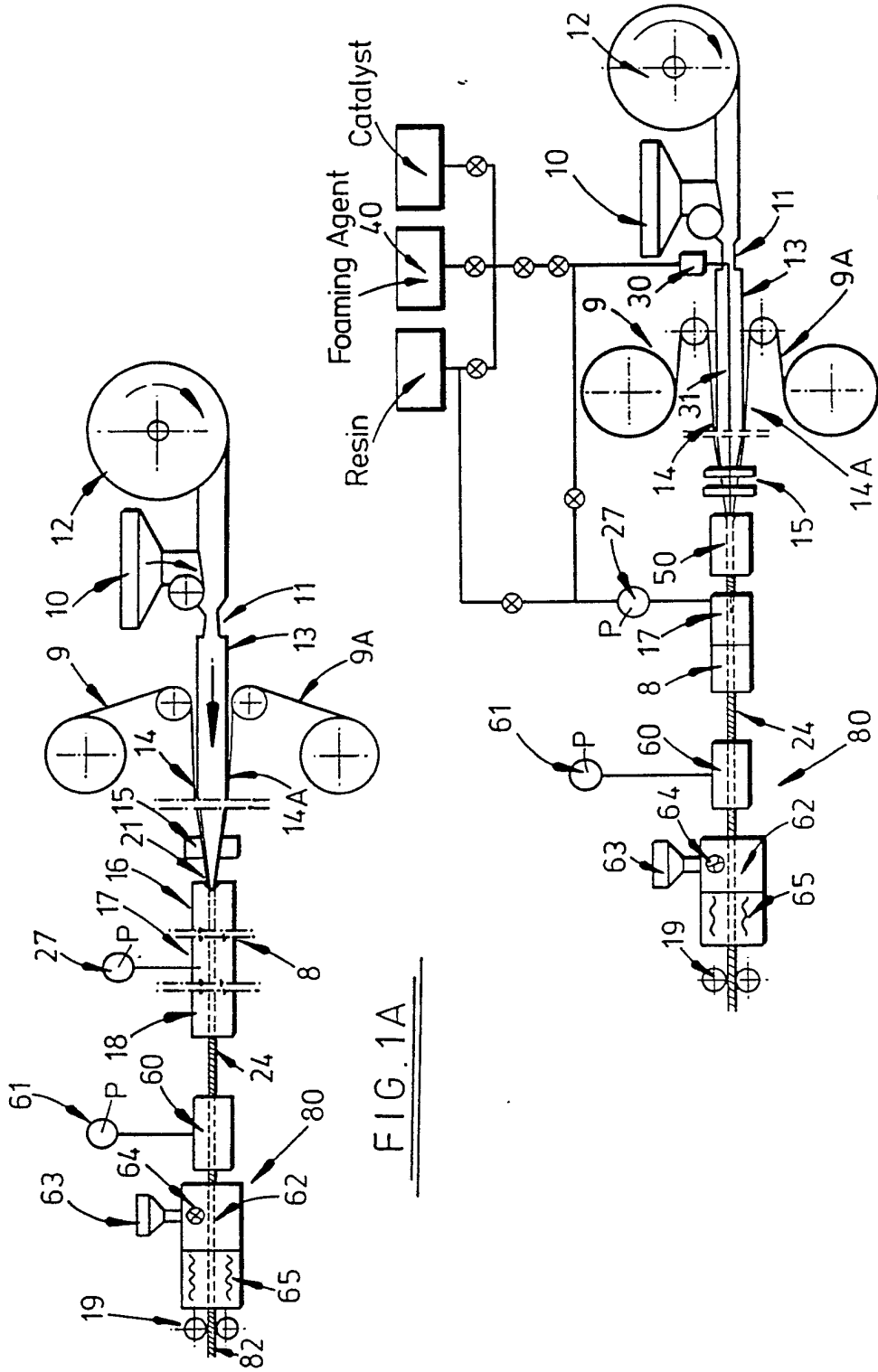


FIG. 1B

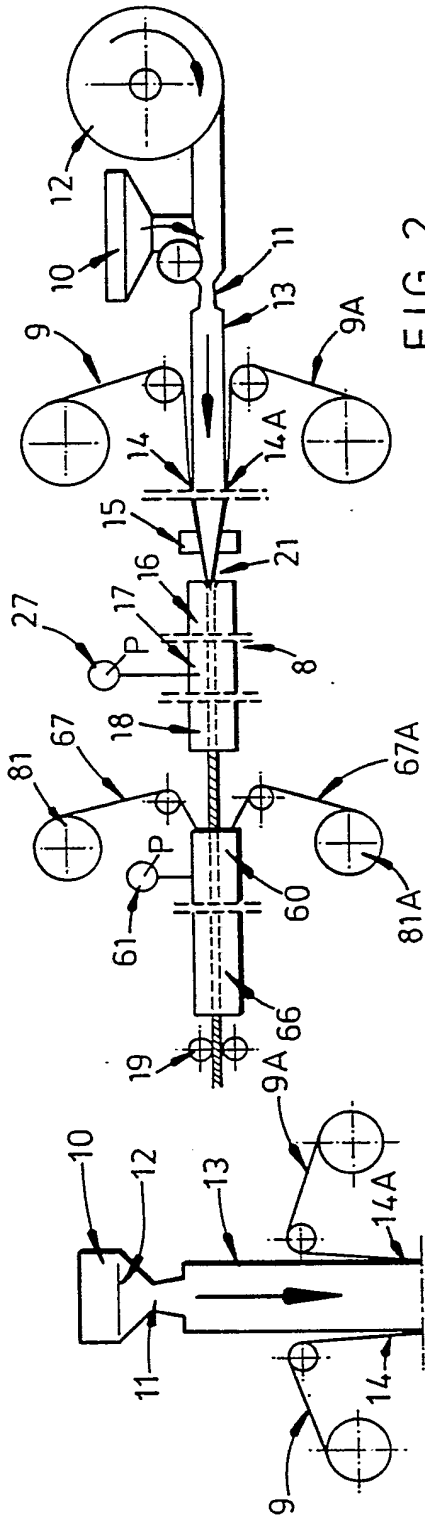


FIG. 2

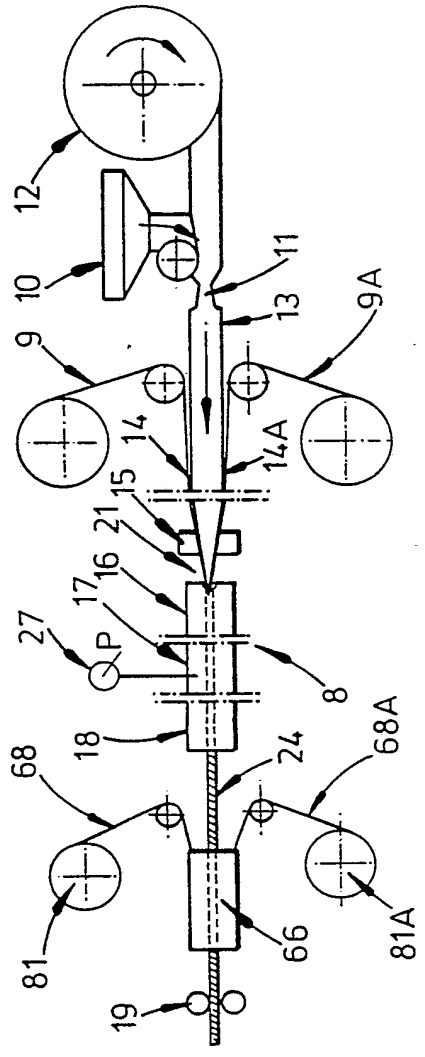


FIG. 3

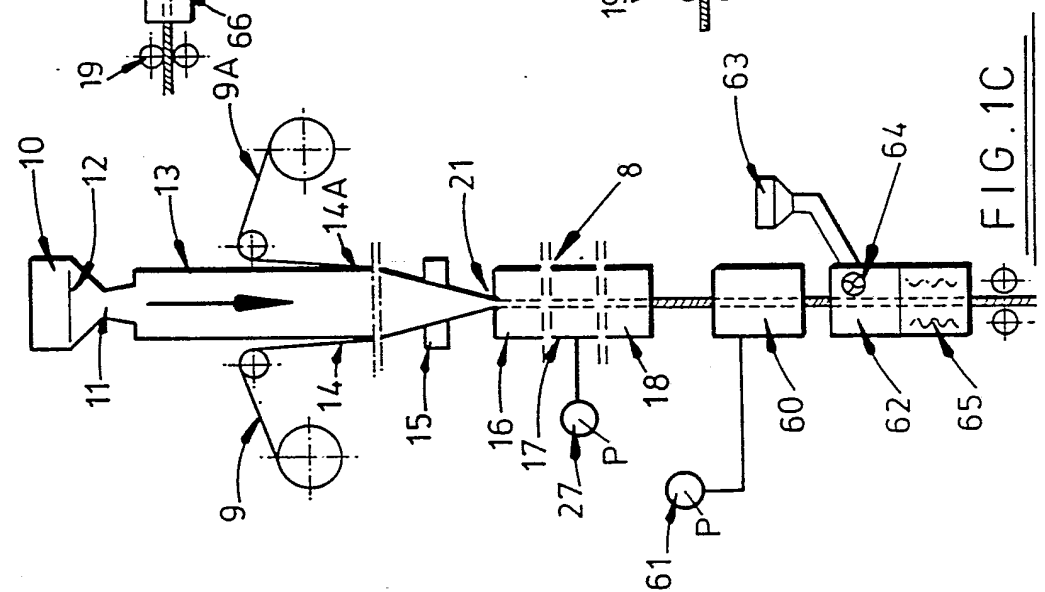
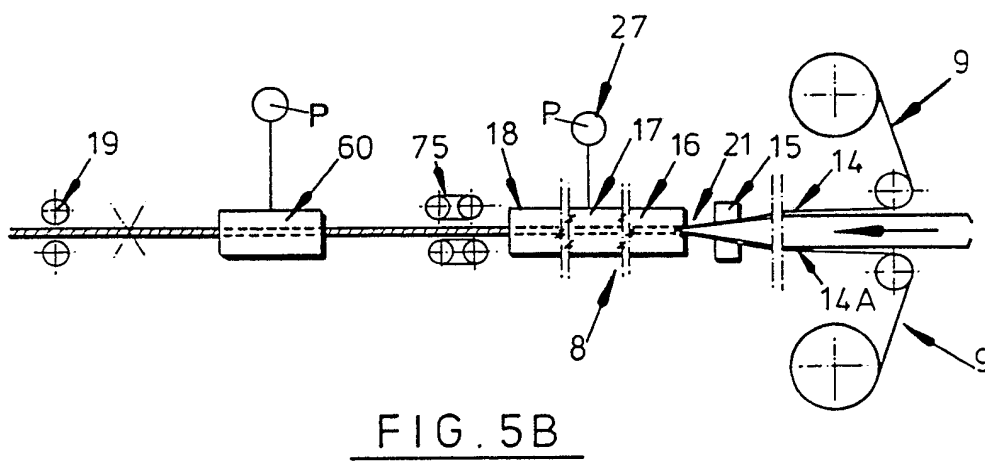
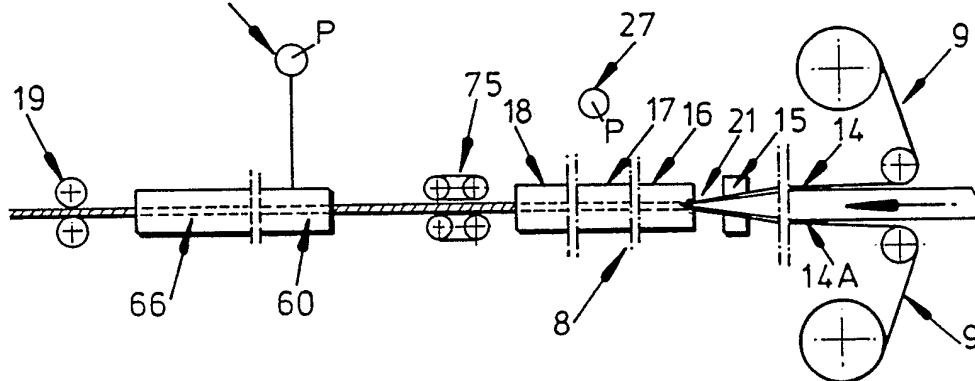
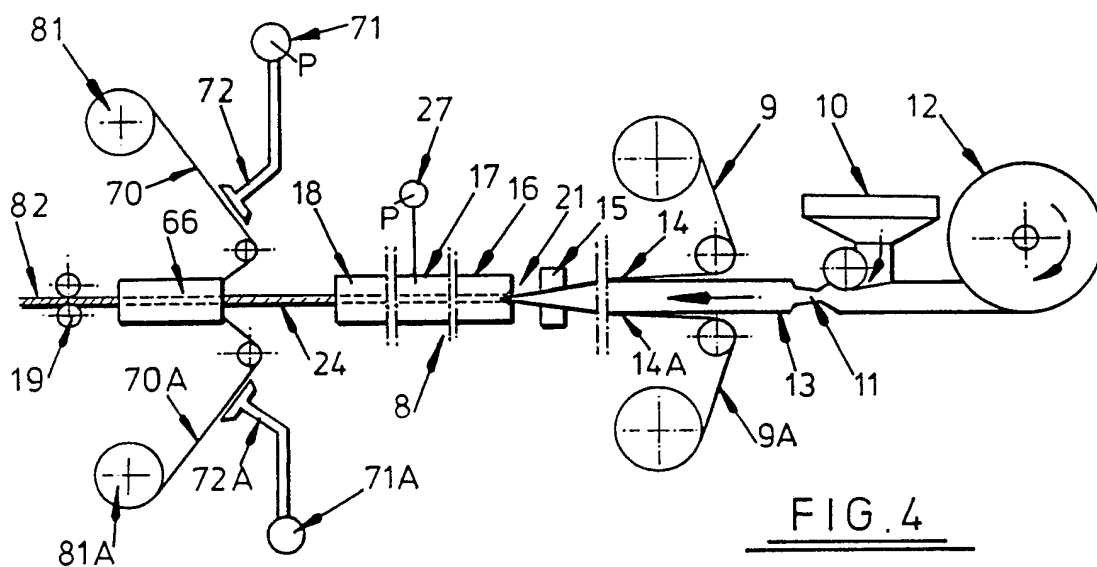


FIG. 1C



PULTRUDED PROFILE SURFACE FINISHING METHODFIELD OF THE INVENTION

This invention relates to a method of manufacturing pultruded profiles having a reinforcing skin and in particular, but not exclusively, to a method for providing a desired surface finish on a cored or non-cored pultruded profile. The invention also relates to apparatus for use in such methods.

BACKGROUND OF THE INVENTION

Various forms of pultruders for the manufacture of in-line core filled pultruded profiles are described in International Patent Specification No. WO88/08367 which discloses an arrangement in which the dry, core forming, materials are fed along a generally horizontal path to a pultrusion die where a bonding resin is injected in a manner which effects complete resin wet through so that the resultant product which emerges from the die has excellent filler bonding and surface finish. The path extends through the interior of a duct which tapers along its length and externally has a cross-sectional shape which changes progressively along its length to conform to the cross-sectional shape of the die. The exterior surface of the duct acts as a guide for runs of dry cloth which are fed to the die to provide a cloth skin as an integral part of the resultant pultrusion.

When compared with other forms of pultruded products having skins formed of, for example, individual fibres woven cloth additionally provides strength in the transverse direction resulting in a profile characterised in an excellent strength to weight ratio. Further, a woven cloth skin provides an envelope to prevent discharge of core filling materials during the pultrusion process. However, the weave of the woven cloth may often be visible in the finished product, which is unacceptable in many applications. This is also true of some conventional pultruded products having skins formed of individual fibres or rovings.

Accordingly, it is an object of the present invention to provide a method of producing pultruded profiles with an improved surface finish.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a method of manufacturing cored and non-cored pultruded profiles comprising feeding a skin forming material to the inlet of a primary pultrusion die station which includes a resin-curing die having a cross-sectional shape for determining the cross-sectional shape of the profile, introducing bonding resin to said station, feeding the resin-bonded primary profile which emerges from the outlet of said primary station through a secondary die station which includes a curing die having a cross-sectional shape substantially similar and slightly

oversize in relation to said primary profile, introducing surface finish material to said secondary die station to coat the primary profile, and pulling the finished profile from the outlet of said secondary station.

With the use of certain skin forming materials, such as cloth, and particularly woven cloth, the material may be discernible in the surface of the primary profile. Further, in many instances it may be desirable to use a relatively coarse woven cloth as a skin forming material, which is clearly discernible in the primary profile, as the cloth serves to scour the surface of the primary profile forming die station and prevents the bonding resin from adhering to the die station walls, and also reduces the force necessary to pull the profile through the die. The surface finishing steps of the method of the present invention allow for provision, in-line, of a desired surface finish which may be, for example, smooth, a textured non-slip surface, or a smooth wood grain effect. Also, certain skin forming materials, such as carbon fibre, may not be coloured as desired and thus may be visible through the cured bonding resin if the profile is to be of a contrasting colour to the skin forming material. The surface finishing steps of the method of the present invention thus further allows for provision, in line, of a surface finish material of desired colour to conceal the skin forming material.

The profile may be subject to pulling solely from,

for example, rollers at the end of the line, beyond the secondary die station, or may additionally be subject to a separate pulling force, applied by, for example, a further set of rollers, at the outlet of the primary die station, facilitating the formation of relatively large or complex profiles which require a greater force to pull them through the die.

The surface finish material may include resin or adhesive applied to the outer surface of the primary profile. The resin or adhesive may be pigmented to produce a profile of a desired colour. Other materials may also be included in the surface finish material, for example granular material, such as sand or grit, to provide a desired surface finish.

The surface finish material may be in the form of a finely textured non-woven veil or mat applied to the outer surface of the primary profile. The material can be coated or impregnated with adhesive or resin, or adhesive or resin may be separately supplied to the secondary die station.

According to a further aspect of the present invention there is provided a method for finishing the surface of pultruded profiles including a skin, the method comprising pulling a profile through a die station including a curing die defining a cross-sectional shape substantially similar to the profile and introducing surface finish material to the die station.

According to a still further aspect of the present

invention there is provided apparatus for finishing the surface of pultruded profiles including a skin, the apparatus comprising a die station including a curing die defining a cross-sectional shape substantially similar to a profile to be finished and means for introducing surface finish material to the die station to coat the profile.

The surface material introducing means may include a resin or adhesive pump, rolls or other means for supplying non woven veils or mats, and granular material distributors.

The curing die may include a heater for curing or setting the surface finish material.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1A, 1B and 1C are diagrammatic illustrations of apparatus in accordance with embodiments of the present invention for use in producing a pultruded profile having a textured or non-slip finish;

Fig. 2 is a diagrammatic illustration of apparatus in accordance with an embodiment of the present invention for use in producing a pultruded profile with a smooth finish;

Figs. 3 and 4 are diagrammatic illustrations of apparatus in accordance with embodiments of the present invention for use in producing pultruded profiles with surface cover embellishment;

Figs. 5A and 5B are diagrammatic illustrations of apparatus for use in producing pultruded profiles in accordance with further embodiments of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

It should be noted that much of the apparatus illustrated in the accompanying drawings is previously described in WO88/08367

Reference is first made to Fig. 1A of the drawings, which illustrates apparatus for use in manufacturing pultruded profiles. It should be noted that the same reference numerals are used in the description and drawings of each embodiment. As will be described, and in common with the other illustrated embodiments, the apparatus includes a primary die station 8 and a secondary die station 80. Briefly, the profile is formed in the primary die station 8 and a surface finish applied to the profile in the secondary die station 80.

The primary die station 8 and the apparatus upstream of the die station 8 will be described initially. Cloth, preferably in the form of two runs of woven fibreglass 14,14A, is delivered by supply rolls 9,9A and guided over the external profiled surface of a former duct 13 to a pre-die former 15, through the dies 16,17,18, of the die station 8 to the secondary die station 80 and subsequently through pulling rollers 19. The duct 13 is hollow and at the end 11 remote from the former 15 there is delivered

particulate core filling material from a hopper 10 borne on an airstream provided by Venturi blower 12. The airstream blows towards the die station 8 and is at least partly diffused through the cloth 14,14A, prior to the resin curing die 18 and forms a body of core filling material filling the space between the runs of cloth 14,14A in the gap between the pre-die former 15 and leading die section 16 of station 8. The cloth runs 14,14A are fashioned to extend around the complete perimeter and occupy the contours of the dies in the station 8 and are held in this configuration through the pre-die former 15 and over part of the exterior surface of the duct 13 which is elongate and is provided with an external shape which progressively along its length conforms to the cross-sectional shape of the resin curing die 18 and at the die station end of the duct 13 is similar in cross-section but oversize in relation to that of the resin curing die 18. The cloth 14,14A is held under slight longitudinal tension by a combination of the effect of supply rolls 9,9A, and rollers 19. When the starter take up rollers 19 are set in motion and cloth 14,14A is pulled, the cloth with its core forming materials progresses through the primary die station 8 which is supplied with resin fed to injection die 17 via a pump 27.

The emergent resin cured profile 24 then passes into the secondary die station 80, initially passing through an

injection die 60, which is supplied with resin fed via a pump 61. The profile 24 is coated with resin in the die 60 and then enters a granular material distribution chamber 62, supplied with granular material such as sand and grit from a hopper 63 through a distribution impeller 64. The granular material adheres to the resin coated profile which is then passed through a radio frequency (RF) heater 65. The emergent finished profile 82 is pulled from the heater 65 by the rollers 19.

Fig. 1B of the drawings illustrates an alternative apparatus in which alternatively or additionally resin may be delivered through the duct 13 to the interior of the space between the cloth runs 14,14A, and with this arrangement the resin may be fed in combination with particulate filler from the hopper 10, or when the resin is of the foaming type which may itself constitute the core for the profile. The injection of resin through the duct 13 is effected by distributed pipes 31 extending along the interior of the duct 13 into a modified forming die section or die station 50 which is spaced from the injection die 17 and has a tapered bore leading portion and a parallel bore trailing portion (not shown). The pipes are distributed over the cross-sectional shape of the die and are fed from a manifold 30 which in turn is fed with the resin components from supply stations 40. Stations 40 are connected via valved and metered pipelines to the manifold and to the pump 27 so that resin can be

fed to either or both and in any combination of foaming or non-foaming resin types.

Reference is now made to Fig. 1C of the drawings which illustrates a vertically arranged apparatus. In this embodiment the hollow duct 13 is vertically disposed and the core filling materials are moved through the duct 13 under the influence of gravity to the die station 8. As the core filling materials are not propelled by an airstream, as described in the apparatus of Figs. 1A and 1B there is no requirement for a variable output Venturi blower. To achieve an even distribution of core filling materials across the cross-sectional area of the profile a vibratory screen 12 may be provided at the top of the duct.

Reference is now made to Fig. 2 of the drawings, which illustrates apparatus using a primary die station 8 and upstream apparatus similar to the embodiment shown in Fig. 1A and described above. However, the secondary die station 80 is somewhat different, there being provided supply rolls 81, 81A for delivering non-woven surfacing veil 67, 67A which is bonded to the exterior of the profile by means of adhesive or resin supplied via pump 61. The resin may be pigmented to produce the desired colour. Pigmented resin when delivered to the profile via pump 61 is cost effective in comparison to pigmented resin being delivered via pump 27 when there is no requirement for the core to be coloured in a similar manner to the external skin.

The veil enters the injection die 60 with the profile and the adhesive is cured in a curing die 66 before the finished profile is pulled from the secondary station.

Fig. 3 of the drawings illustrates a somewhat similar apparatus, in which the surface finishing material is in the form of thermo-setting pre-impregnated surface cover material 68,68A supplied from supply rolls 81,81A to the secondary curing die 66. As the material is pre-impregnated with resin or adhesive, no separate adhesive or resin supply is required.

Reference is now made to Fig. 4 of the drawings, which shows a somewhat similar system but in which the cover material 70,70A is not pre-impregnated, the adhesive and/or resin being supplied from respective applicators 72,72A onto the runs of material, as supplied from appropriate pumps.

Reference is finally made to Figs. 5A and 5B of the drawings, which additionally show secondary pulling systems 75 located between the respective primary die station 8 and a secondary die station 80. The pulling force required to bring the profile through the die stations, and particularly the primary die station 8, varies with the dimensions and complexity of the profile. The provision of a secondary pulling system allows larger and more complex profiles to be accommodated.

By varying the configuration of the secondary die station 80 a wide variety of surface finishes may be

applied, in-line, to a profile, where the skin affects the surface finish of the profile, such as a coarse cloth skin which tends to produce an undulating surface or a carbon fibre skin in which the black fibres may be visible if the profile is of a contrasting colour.

It will be clear to those of skill in the art that the above embodiments are merely exemplary, and that various modifications and improvements may be made thereto without departing from the scope of the invention, in particular, although illustrated only with reference to cored profiles the present invention has application to non-cored profiles.

CLAIMS

1. A method of manufacturing cored and non-cored pultruded profiles comprising: feeding a skin forming material to the inlet of a primary pultrusion die station which includes a resin-curing die having a cross-sectional shape for determining the cross-sectional shape of the profile; introducing bonding resin to said station; feeding the in-line resin-bonded profile which emerges from the outlet of said primary station through a secondary die station which includes a curing die having a cross-sectional shape substantially similar and slightly oversize in relation to said primary profile; introducing surface finish material to said secondary die station to coat the primary profile; and pulling the finished profile from the outlet of said secondary station.
2. The method of claim 1 in which the finished profile is subject to pulling from beyond the secondary die station.
3. The method of claim 2 in which the primary profile is additionally subject to a separate pulling force at the outlet of the primary die station.
4. The method of claim 1, 2 or 3 in which the surface

finish material includes resin or adhesive applied to the outer surface of the primary profile.

5. The method of claim 4 in which the surface finish material is pigmented to produce a profile of a desired colour.

6. The method of claim 4 or 5 in which granular material is included in the surface finish material.

7. The method of any one of the claims 1 to 5 in which the surface finish material is a finely textured non-woven veil or mat applied to the outer surface of the primary profile.

8. The method of claim 7 in which the surface finish material is coated or impregnated with adhesive or resin, or adhesive or resin is separately supplied to the secondary die station.

9. The method of any one of the preceding claims in which the skin forming material is woven cloth.

10. The method of any one of the preceding claims for manufacturing cored profiles including the further step of feeding core forming material to the inlet of the primary pultrusion die.

11. The method of claim 10 including the further steps of: feeding the core forming material to the inlet of the primary pultrusion die through the interior of a hollow duct; and separately feeding skin forming cloth to the inlet of the primary pultrusion die over the external surface of the duct.

12. A method for finishing the surface of pultruded profiles including a skin, the method comprising: pulling a profile through a die station including a curing die defining a cross-sectional shape substantially similar to the profile and; introducing surface finish material to the die station.

13. Apparatus for finishing the surface of pultruded profiles including a skin, the apparatus comprising: a die station including a curing die defining a cross-section shape substantially similar to a profile to be finished; and means for introducing surface finish material to the die station to coat the profile.

14. The apparatus of claim 13 in which the surface finish material introducing means includes a resin or adhesive pump.

15. The apparatus of claim 13 or 14 in which the surface finish material introducing means includes means for

supplying non-woven veils or mats.

16. The apparatus of claim 13 or 14 in which the surface finish material introducing means includes a granular material distributor.

17. The apparatus of any one of claims 13 to 16 in which the curing die includes a heater for curing or setting the surface finish material.

18. A method of manufacturing pultruded profiles substantially as described herein and as illustrated in Fig. 1A, Fig. 1B, Fig. 1C, Fig. 2, Fig. 3, Fig. 4, Fig. 5A or Fig. 5B of the accompanying drawings.

19. Apparatus for finishing the surface of pultruded profiles as described herein and as illustrated in Fig. 1A, Fig. 1B, Fig. 1C, Fig. 2, Fig. 3, Fig. 4, Fig. 5A or Fig. 5B of the accompanying drawings.

- 16 -

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Examiner's report to the Comptroller under
Section 17 (The Search Report)

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ANA; ANC)

(ii) Int CI (Edition 5) B29C 67/00; 67/12 - 67/18;
59/00 - 59/04

Search Examiner

N A FRANKLIN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

24 NOVEMBER 1992

Documents considered relevant following a search in respect of claims

1-19

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevance to claim(s)

Categories of documents

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